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### The predictive validity of the HCR20v3 within Scottish forensic inpatient facilities

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### **Abstract**

The predictive validity of the HCR-20v3 has not been demonstrated in a UK forensic inpatient population. In particular, the validity of insight and positive symptoms of psychosis, two clinical risk factors within the HCR-20v3, require further evidence of their validity in this patient group. In this pseudo-prospective study of N = 167 forensic inpatients, the predictive validity of the HCR-20v3 for violence was examined over the course of a 2 - 12 month follow-up. The predictive validity of insight and positive symptoms were examined in a sub-sample of n = 135. Baseline data were extracted from case-files with violent incidents collected prospectively following HCR-20v3 publication. HCR-20v3 total, clinical and risk management subscale scores significantly predicted violence and physical violence specifically. For violence overall, the clinical subscale demonstrated strongest predictive validity. Post-hoc analyses indicated that even when combined with the risk management subscale, itself a significant predictor, the clinical subscale remained the strongest predictor of violence. Subgroup analyses indicated positive symptoms significantly predicted physical violence, whilst poor insight did not. Forensic inpatient resources should be focused on the risk assessment and management of the HCR-20v3 clinical subscale, with particular emphasis on positive symptoms which show a robust relationship with violence.

**Keywords:** HCR-20v3, violence, risk-assessment, forensic, inpatients

## **Introduction**

Violence by forensic inpatients remains a challenge to services with studies suggesting a third or more patients may behave violently during their admission (e.g., Broderick, Azizian, Kornbluh, & Warburton, 2015; Green, Schneider, Griswold, Belfi, Herrera, & DeBlasi, 2016; Macpherson & Kevan, 2004). Despite risk-management procedures, forensic inpatient violence continues to be a significant concern, having a negative impact on a range of outcomes including patients' safety (Lam, McNeil, & Binder, 2000) and recovery (Olsson, Strand, & Kristiansen, 2014), the therapeutic milieu (McKenzie & Curr, 2005) and the absence rates (Lanctôt & Guay, 2014) and psychological distress of staff (Needham, Abderhalden, Halfens, Fischer, & Dassen, 2005). Inpatient violence also has substantial financial implications for the NHS. In 2014 the estimated annual cost of inpatient violence in NHS England alone was £20.5 million per annum (National Institute of Clinical Excellence [NICE], 2015).

The Scottish Government's Forensic Matrix (Clarke et al., 2011) and the National Health Service (NHS) England (NHS England, 2013) recommend that treatment delivery in forensic services is conducted in accordance with risk assessment and management procedures. In recent years, rather than actuarial methods which may fail to monitor change in risk, the structured professional judgement (SPJ) approach has been advocated (Risk Management Authority [RMA], 2011). Particularly well-established for use in the assessment and management of violence in forensic patients (Campbell, French, & Gendreau, 2009; Khiroya, Weaver, & Maden, 2009), is the Historical Clinical Risk Management-20 (HCR-20; Webster, Eaves, Douglas, & Wintrup, 1995), the second version of which (HCR-20v2; Webster, Douglas, Eaves, & Hart, 1997) was used in more than 35 countries (Douglas, Hart, Webster, & Belfrage, 2013). The

## HCR-20v3 Predictive Validity: A Closer Look at Dynamic Variables

HCR-20 consists of three subscales, the historical scale which includes past and static risk factors, the clinical scale which includes dynamic, clinical factors and the risk-management scale which includes future oriented factors. For research purposes subscales can be summed individually or combined to produce a total score (Douglas et al., 2013).

Despite its widespread use, a meta-analysis by Singh, Grann, and Fazel (2011) found the HCR-20v2 to have only moderate predictive validity for violence across patient groups. For forensic inpatients specifically, meta-analyses (e.g., Campbell et al., 2009; Yang, Wong, & Coid, 2010) have shown the HCR-20v2's clinical subscale to have greater predictive validity than its total score, a finding that has also been supported subsequently (e.g., O'Shea, Picchioni, Mason, Sugarman, & Dickens, 2014). These findings suggest that dynamic, clinical risk factors are of increased relevance to violence in this population.

In highlighting the strength of the clinical subscale, some studies have identified the comparatively poor predictive ability of the historical subscale for forensic inpatients (e.g., Arbach-Lucioni, Andres-Pueyo, Pomarol-Clotet, & Gomar-Sones, 2011; Chu, Thomas, Ogloff, & Daffern, 2011; de Vogel & de Ruiter, 2006). In contrast, Dernevik, Grann, and Johansson (2002), found the historical subscale to be the strongest predictor of forensic inpatient violence but did so in the absence of a standardised classification of violent incidents, classifying incidents, such as 'handling illicit substances', as violent. This behaviour would not meet the criteria of widely used definitions of violence (e.g. World Health Organisation [WHO], 2002) or measurement tools (e.g., the 'Overt Aggression Scale', Yodofsky, Silver, Jackson, Endicott, & Williams, 1986) used by other studies in this field (e.g., O'Shea et al., 2014). Additionally, 'handling illicit substances' is likely encompassed within item H5 (history of problems with

substance-use) and therefore its inclusion as a violent incident may have inflated the historical subscale's predictive ability.

Whilst the HCR-20v2 demonstrated moderate predictive validity for violence and superior validity through its clinical subscale, the system has been updated to the HCR-20v3 (Douglas et al., 2013). Although the HCR-20v3 contains significant modifications, there remain few studies examining its psychometric properties, with none published on its predictive validity in UK forensic inpatients. Those which are available again indicate the clinical subscale's superior performance in this population. For example, Doyle et al. (2014) assessed N = 387 patients discharged from medium security. Patients were followed up at 6 and 12 months, with the clinical subscale showing strongest predictive validity for physical violence at both time points. Violent outcomes were collected via interview with a care co-ordinator and access to police databases. While robust, these methods may by necessity have resulted in an under-estimation of violence rates in comparison with data collected in inpatient settings, where the vast majority of behaviours can be recorded. More recently, Hogan and Olver's (2016) retrospective study of N = 99 forensic inpatients in Canada found the clinical subscale to have incremental predictive validity when historical items were controlled for.

Despite emerging evidence of the clinical subscale's predictive validity for violence in forensic inpatients, there remains discussion around the conceptualisation of its dynamic risk factors (e.g. Cording, Beggs Christofferson, & Grace, 2016; Heffernan & Ward, 2017; Klepfisz, Daffern, & Day, 2016). Guy et al. (2013) provide a rationale for the inclusion of these risk factors in the HCR-20v3 however this is generalised across patient groups and not specific to forensic inpatients. Support for the use of positive symptoms of psychosis, encompassed within item C3, and insight, encompassed within item C1, is particularly poor. Yet arguably, these items can be

most easily assessed using structured measurement tools (e.g., Amador, Marcinko, Seckinger, & Yale, 1999; Kay, Fiszbein, & Opfer, 1987) and are responsive to psychological therapy (Naeem & Kingdon, 2016) providing greater potential for risk management. Furthering our understanding of the predictive validity of insight and positive symptoms of psychosis specifically may provide a valuable contribution to the risk assessment and management of this population.

A meta-analysis by Fazel, Gulati, Linsell, Geddes, and Grann (2009) found psychosis to be associated with an elevated risk of violence. Although most of the excess risk in studies was mediated by substance misuse, risk of homicide was increased in individuals with psychosis, both with and without substance misuse, compared to general population controls. In a meta-regression of 110 studies Witt, Van Dorn, and Fazel (2013) sought to examine more closely which symptoms of psychosis were most associated with violence. They found higher positive but not negative symptom scores to be significantly associated with violence in individuals with psychosis. Thus it is unlikely to be a diagnosis of psychosis per se which is related to violence. Rather, it may be specific clinical variables inherent within psychosis, such as positive symptoms, which hold the greatest predictive validity. In order to provide forensic inpatients with the most effective risk management, it is essential that the risk factors which are operating within HCR-20v3 items are identified. At present, there is a deficiency of clear evidence relating positive symptoms specifically to forensic inpatient violence, despite these being outlined as a risk factor within item C3 (Douglas et al., 2013).

Individuals experiencing psychosis may also lack insight into their mental health difficulties (clinical insight; Amador & David, 1998). As noted previously the HCR-20v3 recognises the potential relationship between insight and violence by its inclusion of item C1 which considers

the relevance of insight into mental disorder, need for treatment and violence risk. Once more however, the evidence supporting this association is mixed. Köşger et al. (2016) and Volavka et al. (2016) found no relationship between insight and violence in civil-psychiatric samples. Yet in forensic inpatient samples positive relationships between poor insight and violence have been demonstrated (e.g., Alia-Klein, O'Rourke, Goldstein, & Malaspina, 2007; Ekinici & Ekinici, 2013). Thus with regard to the relevance of positive symptoms and poor insight for violence risk, there remains both a dearth of evidence to inform best practice and a need to acknowledge that this evidence may differ between forensic inpatients, civil-psychiatric, and community forensic samples.

Although evidence for the predictive validity of the HCR-20v3 is growing and appearing to replicate HCR20-v2 in terms of the strength of the clinical subscale, methodological difficulties within initial studies limit the reliability of findings. Evidence within forensic inpatient samples is particularly limited for all jurisdictions and generalisability to UK forensic inpatients is low. No HCR-20v3 predictive validity research has been conducted within this population despite it being the tool of choice throughout the UK (Forensic Network Scotland Annual Report, 2017; NHS England, 2013). With over 500 patients held in secure accommodation in Scotland (The Mental Welfare Commission, 2017; The State Hospital Annual Report, 2018) and over 7,000 elsewhere in the UK (NHS England, 2013), it is crucial that the validity of the HCR-20v3 for use with this population is established.

The aim of the current study was to assess the predictive validity of the HCR-20v3 total and subscale scores for both 'any violence' and 'physical violence' in a Scottish sample of forensic inpatients. It was hypothesised that the HCR-20v3 total, clinical and risk management subscale scores would significantly predict both types of violence, whilst the historical subscale score was

hypothesised to predict neither. In line with previous research, the clinical subscale was hypothesised to be the strongest predictor of physical violence.

Given our hypothesis that the clinical subscale would most strongly predict physical violence, a secondary aim was to clarify the predictive validity of two of its domains; positive symptoms of psychosis and insight, in a sub-sample of forensic inpatients for whom additional data were available.

### **Methodology**

#### **Design**

A pseudo-prospective cohort design (Douglas, Otto, Desmarais & Borum, 2012) was implemented. Initially, the researcher retrieved HCR-20v3 data previously compiled by clinical teams from patients' case notes. Corresponding data on violent incidents for each patient were then collected from the date of HCR-20v3 publication to a maximum follow-up of 12 months. Data on the small number of violent incidents that took place between HCR-20-v3 publication and the researcher's initial access to the patient's record were therefore retrospective. The majority of remaining incident data, which were collected as they occurred, were collected prospectively.

There were two dichotomous dependent variables, both were measures of inpatient violence. The first, 'any violence', used a broad definition of inpatient violence and included both verbal aggression, e.g. verbal threats, shouting and/or gesturing in an aggressive manner towards others, and physical aggression towards both objects and people. The second, 'physical violence', included physical violence towards others only. Each was scored as either present or absent. The



independent variables were HCR-20v3 total and subscale scores, age, history of violence and positive symptom and insight scores.

### **Setting**

The study sampled data from three NHS Scotland forensic hospitals: The State Hospital (high security), Rowanbank Clinic (medium security) and Rohallion Clinic (medium and low security). Rowanbank and Rohallion are two of only three medium secure hospitals in Scotland, meaning that this study utilised data from two thirds of the medium secure estate. All sites provide care and rehabilitation to patients detained under the Mental Health (Scotland) Act (2003) who have a history of violence and/or have the potential to cause harm to others.

### **Participants**

Opportunity sampling was applied whereby data were collected from the files of all available patients within identified services at the time of data collection subject to the following inclusion criteria: male aged 18+, diagnosed with a mental disorder by a Psychiatrist using DSM5 (American Psychiatric Association, 2013)/ICD10 (World Health Organisation, 1993) criteria and had their violence risk assessed by use of the HCR-20v3 within the last 12 months.

Individuals were excluded from the study if they were female. This was due to an insufficient number of females in the potential overall sample to allow for group comparisons. Individuals diagnosed with an intellectual disability were also excluded due to the potentially different violence risk factors relevant to this patient group (Boer et al., 2012).

### **Measures**

- i) *Risk of Violence*

## HCR-20v3 Predictive Validity: A Closer Look at Dynamic Variables

The HCR-20v3 (Douglas et al., 2013) was used to measure violence risk. The tool was created for use with persons aged over 18 with a history of violence. It assesses 20 risk factors, structured within 3 subscales: Historical (10 items), Clinical (5 items) and Risk-Management (5 items). In practise, items are rated in terms of presence (not present, partially present or present) and relevance (low, moderate or high). This study's focus was on presence ratings which, for research purposes, can be rated as 0 = not present, 1 = partially present and 2 = present (Douglas et al., 2013).

Doyle et al. (2014) found the HCR-20v3 to have good intra-class reliability with coefficients of .92 (total score), .91 (H-scale), .90 (C-scale) and .93 (R-scale). Concurrent validity of the HCR-20v3 to the HCR-20v2 has shown good correlation at .85 (total score), .87 (H-scale), .76 (C-scale), and .67 (R-scale) (Douglas & Belfrage, 2014).

### ii) Previous Violence

Violence precipitating admission was rated by the researcher using the Violence Rating Scale (VRS; Robertson, Taylor, & Gunn, 1987) based on case file information. Case files included Scottish Criminal Record Office (SCRO) records which outlined charges and convictions received in the community for violence. Reports carried out by hospital security managers and social work back-ground reports were also accessed to ensure incidents that had not resulted in charges or convictions were also identified.

The VRS produces a rating for index offence ranging from 0 (completely non-violent) to 4 (severe violence wherein the victim died or life was endangered). It also produces a violence history rating ranging from 0 (never been convicted of violence and never gets into fights) to 4 (one or more severely violent episodes in which someone's life or health was endangered).

Subscale scores are summed to create a total previous violence score. The VRS has demonstrated excellent inter-rater reliability in terms of index offence score ( $r=0.95$ ), history of violence score ( $r=0.82$ ) and total score ( $r=0.85$ ) (Wong, Lumsden, Fenton, & Fenwick, 1993).

### iii) Positive Symptoms and Insight

The Psychosis Evaluation Tool for Common Use by Caregivers-Revised (PECC-R; DeHert, et al., 1998) was used to measure positive symptoms and insight. The PECC-R is an author approved shortened version of the original PECC. It is used routinely as part of nursing assessment in The State Hospital and Rohallion Clinic and thus PECC-R data were available from these sites only. Patients diagnosed with a psychotic disorder and for whom PECC-R data were available comprised the study's sub-sample. As PECC-R assessments were completed on at least a quarterly basis by services sampled, PECC-R data corresponding to the time of each patient's HCR-20v3 publication by the clinical team was obtained.

The PECC-R's positive symptom subscale assesses four symptoms; hallucinations, delusions, grandiosity and thought disorder. After interviewing the patient, each symptom is rated on a scale from 1 (absence of symptom) to 7 (symptom present for more than 50% of the time with a severe impact on functioning). Symptom scores are summed to produce a subscale total, a higher score indicating greater symptom presence and impairment on functioning. The insight subscale assesses two dimensions of clinical insight; i) awareness of having a mental illness and ii) awareness of symptoms being attributable to a mental illness. The subscale uses a four point rating scale ranging from 1 (good insight) to 4 (completely absent of insight). A higher score represents lower levels of insight.

The positive symptom and insight subscales within the PECC-R are retained in full from the original fully validated PECC. DeHert, et al. (2002) found the PECC to have good inter-rater reliability across all symptom categories, with agreement never falling below  $r=0.80$ . Concurrent validity of PECC positive and negative symptom subscales to the PANSS is also very good ( $r=0.95$ ).

iv) Inpatient Violence

The Overt Aggression Scale (OAS; Yudofsky et al., 1986) was used to measure inpatient violence. Designed to measure violence in adults and children, the OAS is frequently applied in research to ensure standardised categorisation of violent behaviours.

The OAS divides violence into four categories: verbal aggression, physical aggression against objects, physical aggression to self and physical aggression against others. Operationally, violent incidents were considered within the definitions provided by Yudofsky et al. (1986). As such, physical violence to others was rated present using the OAS if patients had behaved in any of the following ways: made threatening gestures towards others, swung for others, grabbed clothing, struck, kicked, pushed, pulled and/or pulled hair, physical attacks causing mild-moderate injury such as bruises, sprains and welts and physical attacks towards others causing severe physical injury such as broken bones, deep lacerations and internal injuries. As this study was interested in interpersonal violence, the ‘physical aggression against self’ category was not utilised. O’Shea et al. (2014) found excellent agreement in OAS violence category ratings between three researchers in a sample of 260 incidents ( $K=0.91$ ).

v) Demographics

Demographic information relating to age and DSM-5/ICD-10 diagnosis, as made and recorded by Consultant Psychiatrists was extracted from case files.

### **Procedure**

#### *Ethical Approval*

Following proportionate review, ethical approval was granted by London City and East ethical review board (REC number: 15/LO/1874). Site specific research and development committees approved the project and National Caldicott granted access to NHS patient data across sites.

#### *Baseline Data Collection*

As HCR-20v3s were completed on an ongoing basis, data were collected as it became available. The following data were extracted from patient case files: HCR-20v3 total and subscale scores, site, age, diagnosis, VRS previous violence scores and PECC-R positive symptom and insight subscale scores. All baseline data with the exception of previous violence was coded and available in case files at the time of access. For example, HCR-20v3s were coded by clinical teams and PECC-R assessments were rated by nursing staff as per routine clinical practice. Conversely, previous violence was coded using the VRS by the primary researcher based on file information. The primary researcher was a doctoral candidate in clinical psychology trained in the administration and scoring of all utilised assessments.

#### *Follow-up Data Collection*

In keeping with the study's focus on dynamic, shorter term risk factors and in line with similar studies (e.g., O'Shea et al., 2014), violence data were collected for a minimum of two and a maximum of twelve months following the HCR-20v3 publication. This follow-up period was

also selected with the knowledge that HCR-20v3's were updated on at least an annual basis by services. All violent incidents were recorded by staff on DATIX. DATIX is an industry leading electronic reporting system for the recording of adverse events within healthcare settings. Each site's risk management department reviewed accounts of incidents to ensure the correct DATIX category was used. After the follow-up period, administrators provided reports of violent incidents in the form of DATIX categories together with incident narratives to the primary researcher who matched each incident to the relevant participant. Therefore, although the researcher was not blinded to outcomes, they also had no control or influence over outcomes as these were supplied by risk-management departments. Each incident was coded using the OAS by the primary researcher before being classified as 'any' or 'physical violence' for subsequent analysis. Patients were then dichotomised as 'violent' or 'non-violent' within each of the two classifications.

### **Data Analytic Considerations**

#### *Inter-Rater Reliability*

Cohen's Kappa (K) (Cohen, 1960) was used to assess for potential bias in variables which were coded by the researcher using patient case-files and unblinded violence outcome data extracted from DATIX. A second clinician, a Consultant Clinical Forensic Psychologist trained in the administration and scoring of all utilised assessments, therefore coded 41 (10%) violent incidents using the OAS and also completed the VRS for 23 (14%) patients. Inter-rater agreement on OAS categories was found to be excellent ( $K = .95, p = .001$ ). Agreement on VRS index offence ( $K = .71, p = .001$ ) and previous violence ratings ( $K = .612, p = .001$ ) were both substantial.

#### *Apriori Power Analysis*

For the primary research question, using a ratio of 2:1 in favour of non-violence, 'MedCalc' calculated minimum sample size requirements for Receiver Operating Characteristic (ROC) analysis as 42 cases in the non-violent group and 21 in the violent group. For the secondary research question, the minimum sample size based on 4 predictors in a logistic regression model was 133.

### **Data Analytic Methods**

Data were analysed using SPSS version 19. Levene's test was used to verify equality of variance across groups and the Kolmogorov-Smirnov test confirmed data were normally distributed, indicating the use of parametric statistics was appropriate (Field, 2014). T-Tests were used to compare risk ratings between violent and non-violent groups.

### **Whole Sample Predictive Validity Analyses**

Areas under the curve (AUC) of ROC analyses were used to examine the predictive validity of HCR-20v3 total and subscale scores for violence. ROC curves measure the sensitivity in comparison to the specificity of a diagnostic tool. The AUC value is generated by the ROC curve and is a measure of how well a tool can distinguish between membership of two opposing groups e.g., violent and non-violent. AUC values range between 0 and 1 with higher values indicating greater predictive accuracy. An AUC value of 1 would therefore represent perfect discrimination between individuals who go on to behave violently and those who do not. Conversely, an AUC of 0.5 is considered equivalent to chance. Less than 0.5 indicates that the tool has no ability to discriminate (Park, Goo, & Jo, 2004). AUC values above 0.75 are considered large effect sizes (Dolan & Doyle, 2000).

### **Sub-Sample Predictive Validity Analyses**

## HCR-20v3 Predictive Validity: A Closer Look at Dynamic Variables

For the sub-sample of patients diagnosed with a psychotic disorder and with PECC-R data available in their case-files, ROC analyses was again carried out to clarify the predictive validity of the HCR-20v3 total and subscale scores for both violence types. Pearson correlations were used to investigate univariate relationships between anticipated predictor variables and violence types. Logistic regression was then conducted using the hierarchical entry procedure to calculate the probability that violence would occur based on variables which significantly correlated with violence.

### **Results**

#### **Primary Analyses**

##### Participant Characteristics

Primary analyses comprised N = 167 patients. 30 patients were sampled from both Rohallion and Rowanbank Clinics respectively. The remaining 107 patients were sampled from The State Hospital. The mean patient age was 42. The majority of patients (68.3%) were diagnosed with a schizophrenia spectrum disorder. An additional 24.6% of patients were diagnosed with a schizophrenia spectrum disorder with co-morbid personality disorder. Consequently, 92.9% of the sample had a schizophrenia spectrum disorder. Other diagnostic groups such as affective and neuro-developmental disorders were not of significant size to justify comparisons.

Over half (56.8%) of patients had committed an index offence which involved severe violence where the victim died or their life and/or health was seriously endangered. Almost a third (32.9%) of patients had a significant history of violence involving three or more violent convictions.

##### Rates of Inpatient Violence



## HCR-20v3 Predictive Validity: A Closer Look at Dynamic Variables

The mean length of follow-up was 8.35 months (SD=3.65; range 2-12 months). During follow up, 417 incidents of ‘any violence’ were recorded which included 106 incidents of ‘physical violence’. Sixty three (37.7%) patients carried out ‘any violence’ of whom 33 (19.7%) were physically violent.

### Differences between Violent and Non-Violent Groups

HCR-20v3 total scores were significantly higher for violent than for non-violent patients for ‘any violence’,  $t(165) = -3.87, p = .001$  and ‘physical violence’,  $t(165) = -3.49, p = .001$ . Clinical subscale scores were also significantly higher for violent patients for ‘any violence’,  $t(165) = -4.95, p = .001$  and ‘physical violence’,  $t(165) = -4.91, p = .001$ . Risk management subscale scores were again significantly higher for violent patients for ‘any violence’,  $t(165) = -3.12, p = .002$  and ‘physical violence’,  $t(165) = -3.23, p = .001$ . There were no differences between violent and non-violent patients in historical subscale scores for either violence type. There were no significant differences in age or VRS scores between violent and non-violent patients.

### The Predictive Validity of the HCR-20v3

ROC analyses determined the utility of HCR-20v3 total and subscales scores in predicting ‘any violence’ and ‘physical violence’ (Table 1). AUCs ranged between .51 and .77 with HCR-20v3 total, clinical and risk-management subscales all significantly predicting both violence types. The historical subscale was not predictive of either violence type. AUC values overall were larger for the prediction of ‘physical violence’ than for ‘any violence’ and the clinical subscale was the strongest predictor of both violence types.

For ‘any violence’ the HCR-20v3 total score (AUC = .69) predicted violence to a lesser extent than the clinical subscale (AUC = .72). For ‘physical violence’ the HCR-20v3 total score (AUC

= .70) was again less predictive than the clinical subscale score (AUC = .77) alone. Smaller AUC values were found for the risk-management subscale for both violence types, although these remained significantly<sup>1</sup> greater than chance.

*<Insert Table 1>*

### Post-hoc Analyses

Post-hoc analyses were conducted to examine the lower predictive validity of the HCR-20v3 total score in comparison to the predictive validity of the HCR-20v3 clinical subscale score. A ROC curve was calculated using a ‘revised total’ which included only the clinical and risk-management subscales. Although this revised total provided an increased AUC of .71 for ‘any violence’, the improved AUC was still below that of the clinical subscale alone for this violence type (AUC = .72). The same pattern was shown for prediction of ‘physical violence’ by the ‘revised total’, which increased the AUC to .73 however did not reach that of the clinical subscale (AUC = .77). These results suggest that the clinical subscale is better able to predict violence independently than when it is combined with remaining HCR-20v3 subscales.

### **Sub-Sample Analysis**

Given that previous studies had demonstrated the clinical subscale’s value in predicting inpatient violence, the relationship between two dynamic variables, clinical insight and positive symptoms to inpatient violence was examined in a sub-sample of patients for whom data were available (N = 135). ROC analyses for the sub-sample again found the clinical subscale to produce the highest predictive values for both ‘any violence’, AUC = .74 and ‘physical violence’, AUC = .75.

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<sup>1</sup> Please see Appendix 1 for all ROC plots of significant AUC values.

### Correlations between Independent Variables and Violence

VRS history of violence score was significantly associated with ‘any violence’  $r = .18, p = .035$  but not ‘physical violence’. The PECC-R positive symptom score was significantly associated with both ‘any violence’  $r = .27, p = .001$  and ‘physical violence’  $r = .23, p = .006$ . There were no significant correlations found between PECC-R insight score or patient age or either violence type (Table 2).

*<Insert Table 2>*

### Logistic Regression Model of Physical Violence

As PECC-R positive symptom score alone was significantly associated with ‘physical violence’, only this variable was entered into a logistic regression model. The model correctly classified 75.6% of violent and non-violent cases, being more precise at classifying non-violent (98.0%) than violent (6.1%) cases correctly. The Wald statistic indicated that patients with higher positive symptom scores had a 6.8 fold greater risk of being violent, with positive symptoms making a significant contribution to violence prediction ( $p = .009$ ).

*<Insert Table 3>*

### **Discussion**

Following an update to the HCR-20 system, this study was the first to examine the predictive validity of the HCR-20v3 in relation to forensic inpatient violence in a Scottish sample. Our primary hypotheses were supported. HCR3-v3 total, clinical and risk management subscale scores significantly predicted violence. Additionally, the clinical subscale demonstrated the strongest predictive validity for both any violence and physical violence specifically. As hypothesised, the historical subscale did not predict either category of violence. These findings

support those of previous studies identifying the superiority of the clinical subscale for predicting violence in forensic inpatients (e.g., Hogan & Olver, 2016). Subgroup analyses sought to contribute further to the evidence supporting the use of insight and positive symptoms of psychosis within the clinical subscale. These analyses indicated that both positive symptoms and history of violence significantly predicted ‘any violence’, whilst only positive symptoms predicted ‘physical violence’. Our secondary hypothesis, that insight would predict ‘any violence’ and / or ‘physical violence’ was not supported.

### **The Predictive Validity of the HCR-20v3**

The HCR-20v3 clinical subscale demonstrated the largest effect sizes for both violence types and was most predictive of ‘physical violence’. Such accurate prediction of physical violence by the clinical subscale is encouraging for the HCR-20v3 system considering this form of violence is of most concern to NHS services (Renwick et al., 2016). The dominance of the clinical subscale supports findings from HCR-20v2 studies that highlighted its strength in predicting physical violence in forensic inpatients (e.g., Macpherson & Kevan, 2004; O’Shea et al., 2014; Wilson, Desmarais, Nicholls, Hart, & Brink, 2013).

Our findings also support those of initial HCR-20v3 predictive validity studies conducted with forensic patients in the community (e.g., Doyle et al., 2014). Although speculative to compare the violence of forensic inpatients to that of forensic outpatients, the clinical subscale being the strongest predictor of violence across settings reinforces its utility for forensic patients more widely. What is notable within Doyle et al. (2014) and the current study is that for forensic samples, clinical subscale AUC values were equal to or in the majority of cases greater than HCR-20v3 total score AUCs. This suggests that the clinical subscale is independently better at predicting both types of violence than when combined with remaining subscales. In post-hoc

analyses within the current study this observation was confirmed, the clinical subscale demonstrates greater predictive validity for violence independently than does the total score or when combined only with the risk-management subscale.

The strength of the clinical subscale over the HCR-20v3 total may be linked to the characteristics of forensic patients. Certainly, Nicholls, Ogloff, and Douglas (2004) demonstrated that the HCR-20v2 clinical subscale score was not as powerful a predictor for civil-psychiatric inpatients as it was for forensic inpatients. A number of studies have also highlighted the poor utility of the HCR-20v2 historical subscale for violence in forensic inpatients (e.g., Macpherson & Kevan, 2004; O'Shea et al., 2014) and this effect appears to have continued in the HCR-20v3. Crucially, forensic inpatients are likely to have experienced the majority of items on the historical subscale. As such, they tend to score higher than civil-psychiatric patients and highly overall. This results in less variance within the historical subscale and therefore lower predictive value contributing towards the total score. In contrast, due to its dynamic nature there is greater room for variation in scores on the clinical subscale thereby facilitating the opportunity for greater predictive validity.

Although the risk-management subscale was found to be predictive of violence in our study, AUC values were low. Dernevik et al.'s. (2002) study of the HCR-20v2 with forensic inpatients also showed significant yet low risk-management AUC values, whilst the subscale did not reach significance within Macpherson & Kevan's (2004) study. In contrast, the HCR-20v3 risk-management subscale has demonstrated enhanced predictive ability for violence within forensic community samples (e.g., Doyle et al., 2014). This is perhaps due to greater relevance of risk management items to community patients. Indeed, the significant predictive validity of this subscale in our own study may be attributable to the range of institutions included. Our finding

that the predictive validity of the clinical and risk management subscale scores combined was no better than the clinical subscale alone suggests that risk factors within the risk management subscale may be not be wholly relevant to forensic inpatients.

The observed superiority of the clinical subscale is consistent with a wealth of research outlining the value of dynamic variables within violence risk assessment (e.g., Desmarais, Nicholls, Wilson, & Brink, 2012; Johnson et al., 2016; Wilson et al., 2013). In particular our findings support those of Hogan and Olver (2016) who found HCR-20v3 dynamic risk factors to be more accurate at predicting forensic inpatient violence when historical subscale items were controlled for. The same study also found that the dynamic risk factors contained within the short-term assessment of risk and treatability (START; Webster, Martin, Brink, Nicholls, & Desmarais, 2009) and the dynamic risk factors within the violence risk scale (VRS; Wong & Gordon, 2006) showed enhanced predictive validity when static risk factors were controlled for. Likewise, improvement and deterioration in dynamic risk factors has been prospectively associated with reduced and increased violence in forensic inpatients, further indicating their importance in the risk management of violence in this population (De Vries- Robbe, de Vogel, Douglas, & Nijman, 2015; Penney, Marshall, & Simpson, 2016).

These findings provide empirical support for understanding violence risk as a dynamic construct (Douglas & Skeem, 2005) and highlight a requirement for the field to develop an enhanced understanding of the role of dynamic risk factors in relation to forensic inpatient violence. In forensic inpatient settings we suggest that the clinical subscale is afforded enhanced consideration during the application of the HCR-20v3 to promote more active and rigorous risk-management of these factors.

### **Positive Symptoms as a Risk-Factor for Violence**

Despite growing evidence for the importance of dynamic risk factors within violence risk assessment, evidence for the predictive ability of specific dynamic risk factors remains limited (Wilson et al., 2013). Our finding that positive symptoms of psychosis significantly predict physical violence provides evidence that a small minority of forensic inpatients with greater positive symptoms may be more likely to exhibit violent behaviour.

Earlier support for positive symptoms as a risk factor for violence in civil-psychiatric inpatient (Arango, Calcedo-Barba, González-Salvador, & Calcedo-Ordóñez, 1999; Nolan et al., 2003), high-risk community patients (Hodgins, Hiscoke, & Freese, 2003; Swanson et al., 2006) and community forensic samples (Lincoln & Hodgins, 2008) can now be extended to forensic inpatients.

Our measure of positive symptoms comprised a composite of four symptoms (hallucinations, delusions, grandiosity and thought disorder). It may be for this reason that our results differ to those of Monahan et al. (2000) who found no evidence that positive symptoms predicted violence. Perhaps, rather than individual symptoms, it is the experience of positive symptoms holistically that contributes towards violence. Indeed positive symptoms are certainly only one of a number of variables which contribute towards violence risk in forensic inpatients (Bonta, Blais, & Wilson, 2014). Recognition of their significance is however valuable as they can be identified within risk assessment, taken account of in risk management (Monahan & Skeem, 2016) and are amenable to psychological intervention (Naeem & Kingdon 2016). These opportunities are in line with forensic mental health policy which seeks to offer patients interventions to reduce their level of risk in order to progress with recovery and rehabilitation (Clark et al., 2011).

### **Insight as a Risk Factor for Violence**

Our finding that insight was not associated with violence contributes to the debate regarding its validity as a violence risk factor (Lincoln & Hodgins, 2008). Our findings should however be considered with caution due to the complex nature of insight and its conceptualisation and the difficulties inherent in its measurement (McCormack, Tierney, Brennan, Lawlor, & Clarke, 2013). Although the PECC-R aims to assess clinical insight, it is a brief two item measurement using only staff ratings. Previous studies investigating insight and violence in psychosis which applied the comprehensive Scale to Assess Unawareness of Mental Disorder (SUMD; Amador et al., 1993) (e.g., Alia-Klein et al., 2007; Ekinci & Ekinci, 2013; Goodman, Knoll, Isakov, & Silver, 2005) found a positive association between poor insight and violence. In contrast, studies which utilised briefer scales (e.g., Foley et al., 2005; Fresan et al., 2005) did not demonstrate this relationship. It may be that shorter scales are less able to fully capture the complexity of insight in psychosis, with the PECC-R possibly affected by similar measurement limitations. Future research may wish to further examine the components of the measures used to assess insight, including their length, their use of staff or self-report ratings and the underlying insight construct which they aim to measure.

### **Implications for Violence Risk Assessment and Management**

The relationship between positive symptoms and forensic inpatient violence highlights an area of development for the HCR-20 system. The HCR-20v3 user manual (Douglas et al., 2013) refers to ‘psychotic symptoms’ as a whole within item C3 and does not differentiate positive and negative symptoms, despite the latter continuing to demonstrate a negative relationship with violence (e.g., Fazel et al., 2009; Knezevic et al., 2017; Swanson et al., 2006). Consideration should be given to more clearly identifying positive symptoms as a specific risk factor in the manual. Raters should also be mindful of the relevance of positive symptoms to forensic



inpatient violence and ensure they are re-assessed regularly with a structured measurement tool, as part of HCR-20v3 processes.

Our findings also question the utility of the HCR-20v3 historical subscale for forensic inpatients. There appears to remain a place for the assessment of historical risk factors, particularly due to the richness of information they provide for formulation. However the historical subscale and indeed the total score appear to provide little additional value to the clinical subscale when assessing violence risk in forensic inpatients. Subsequent to replication of this study, there may be potential for the clinical subscale to be used independent of the remainder of the HCR-20v3 in forensic inpatient environments. In the interim, it is recommended that resources are prioritised around the assessment of factors present within the clinical subscale. As a minimum, these dynamic risk factors should be explicitly measured, with reliable assessment tools that are sensitive to change, prior to ratings being provided.

### **Limitations**

This study utilised risk assessments completed for the purpose of clinical care rather than research, resulting in a rolling period of baseline data collection. Data collection took place over a pre-specified period and the decision was made to maximise data collected by extracting all follow-up data available for each case at the end of this period. This approach resulted in follow up periods ranging from two to twelve months. While previous studies have used follow up periods as short as three months (e.g., O'Shea et al., 2014), it is possible that for cases with shorter follow up periods a low base rate of violence limited our ability to identify an effect.

During our subgroup analyses we chose not to control for variables known to co-vary in the psychosis-violence relationship, most notably substance misuse (van Dorn, Volavka, & Johnson,

2012) and psychopathy (Bo, Abu-Akel, Kongerslev, Haahr, & Simonsen, 2011). Substance misuse has been found to account for a large proportion of variance in the prediction of community violence by individuals with psychosis (Fazel et al., 2009). Nonetheless its relationship to violence appears to be reduced within inpatient settings (Stewart & Bowers, 2015), particularly those subject to the strict security procedures of the forensic institutions sampled. Similarly, psychopathy is a strong predictor of violent recidivism in community samples (Vitacco, Neumann, & Pardini, 2014), yet McDermott, Edens, Quanbeck, Busse, and Scott (2008) found the HCR-20v3 clinical and risk-management subscales to be superior to psychopathy when predicting violence in forensic inpatients. Additionally, although personality disorder is included in criteria for detention by the Mental Health (Scotland) Act (2015), practice in Scotland is that patients are not admitted to forensic mental health facilities with a primary diagnosis of personality disorder. This suggests that psychopathy rates are likely to be lower in Scotland than in England and/or other countries.

Our subgroup analyses also utilised routinely collected PECC-R data to derive a measure of insight rather than a more comprehensive tool. Although the PECC-R had the advantage of being a brief and ecologically valid tool that measures insight in an identical manner to the original PECC, it may have lacked sensitivity for this construct.

### **Future Research**

Replication of this study utilising a longitudinal sample large enough to allow analyses of the predictive validity of the HCR-20v3, its subscales and specific items such as insight and positive symptoms at different time points would be valuable. Further support for the predictive validity of the HCR-20v3 clinical subscale would contribute to a growing evidence base around its utility and could create a strong case for its independent use in forensic inpatient settings. It would also

be advantageous to develop an increased understanding of the predictive validity of the remaining clinical subscale risk factors; violent ideation, instability and treatment/supervision response, which this study did not measure. The relationships between the five clinical risk factors could also be examined, particularly regarding how these change over time. Lastly, the HCR-20v3 identifies insight as multi-dimensional construct and it would be reasonable to question whether each of these dimensions might relate differentially to inpatient violence risk.

### **Conclusions**

We believe this to be the first study to investigate the predictive validity of the HCR-20v3 in a Scottish sample of forensic inpatients. The HCR-20v3 was found to have reasonable predictive validity for inpatient violence and physical violence specifically through its total score. Superior validity was demonstrated independently by the clinical subscale score. For this unique group of patients, dynamic, clinical risk factors appear to be more valuable in short term violence risk assessment and management than historical or future oriented factors. In a sub-sample of patients with psychosis, positive symptoms significantly predicted inpatient violence and physical violence specifically. Insight did not predict either category of violence. This suggests that insight as a violence risk factor requires further examination, particularly given its specificity in the HCR-20v3. The comparative importance of violence risk factors for forensic inpatients appears to differ from those of other patient populations with dynamic risk factors, such as positive symptoms, being of increased importance to this group. It is recommended that health-care professionals prioritise the HCR-20v3 clinical subscale, and positive symptoms in particular, when assessing and managing risk of violence. This recommendation is made with the caveat that the use of insight as a risk factor for violence in forensic inpatients continues to require further empirical support.

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